DERWENT-ACC-NO: 2000-333423

DERWENT-WEEK: 200104

TITLE: Soft magnetic alloy for biological environment, consist of specific composition with platinum as principal component and specific values for coercive force and magnetic flux density

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PRIORITY-DATA: 1998JP-0311570 (September 28, 1998)

PATENT-FAMILY:

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INT-CL (IPC): A61C008/00, C22C038/00 , H01F001/14

ABSTRACTED-PUB-NO: JP2000104141A

BASIC-ABSTRACT:

NOVELTY - The soft magnetic alloy has Pt 17-37% as principal constituent. By performing a process and heat treatment coercive force Hc is set to 10 or Oes, and saturation magnetic flux density Bs is set to 10kgs or more.

DETAILED DESCRIPTION - The composition of the alloy by atomic ratio is Pt 17-37%, Cr, Co, Ni at most 25%, Si, Ti, Mn, Cu, Ge, Y, Pd, Ta, Nb, Mo, W, Ir, Ag and Au, B, C, Al in one or more combination constitutes upto 35% and small amounts of impurities upto 10% or less, remainder being Fe.

USE - In dentistry and other medical application due to its high corrosion resistance and soft magnetic properties.

ADVANTAGE - The magnetic alloy has high biocompatibility and biological toxicity is eliminated due to presence of Pt. Due to high corrosion resistance, it is used in dentistry and functionality components for embedding in the human body. Platinum is very safe. The soft magnetic properties are improved.

CHOSEN-DRAWING: Dwg.1/4

TITLE-TERMS: SOFT MAGNETIC ALLOY BIOLOGICAL ENVIRONMENT CONSIST SPECIFIC

PAT-NO: JP02000104141A

DOCUMENT-IDENTIFIER: JP 2000104141 A

TITLE: SOFT MAGNETIC ALLOY EXCELLENT IN CORROSION RESISTANCE

PUBN-DATE: April 11, 2000

INVENTOR-INFORMATION:

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ASSIGNEE-INFORMATION:

NAME	COUNTRY
RES INST ELECTRIC MAGNETIC ALLOYS	N/A

APPL-NO: JP10311570

APPL-DATE: September 28, 1998

INT-CL (IPC): C22C038/00, A61C008/00 , H01F001/14

ABSTRACT:

PROBLEM TO BE SOLVED: To provide a soft magnetic alloy which is hardly changed chemically even if being exposed to severe environments such as the insides of the living body and oral cavity and excellent in corrosion resistance, particularly a soft magnetic alloy exhibiting most excellent corrosion resistance by making a structure in the combination with an Fe-Pt permanent magnet alloy.

SOLUTION: This alloy is a high corrosion resistance soft magnetic alloy contg., by atomic ratio, 17 to 37% Pt as the main component, contg. 0.001 to 35% in total one or more kinds among Cr, Co and Ni respectively by ≤25% and B, C, Al, Si, Ti, Mn, Cu, Ge, Y, Pd, Ta, Nb, Mo, W, Ir, Ag and Au respectively by ≤10% as assistant components, and the balance Fe with a small amt. of impurities, and by executing working and heat treatment, its coercive force Hc is made to be ≤10 Oe, its saturation magnetic flux density Bs is made to be ≥10 kG, and excellent soft magnetic properties can be obtd.

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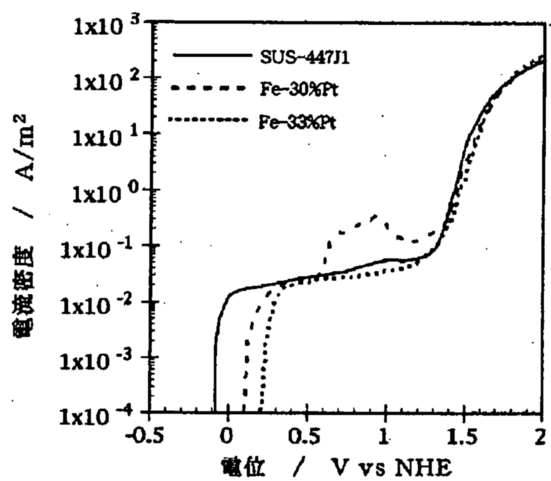
(54)【発明の名称】　耐食性に優れた軟磁性合金

(57)【要約】
【課題】　腐食性雰囲気中，例えば生体および口腔内のような苛酷な環境に曝されても，化学的変化を生じ難い耐食性に優れた軟磁性合金を提供する。特に，Ｆｅ－Ｐｔ系永久磁石合金と組合わせた構造とすることにより，最も優れた耐食性を発揮する軟磁性合金を提供する。
【解決手段】　原子比にてＰｔ１７～３７％を主成分とし，副成分としてＣｒ，Ｃｏ，Ｎｉのそれぞれ２５％以下，Ｂ，Ｃ，Ａｌ，Ｓｉ，Ｔｉ，Ｍｎ，Ｃｕ，Ｇｅ，Ｙ，Ｐｄ，Ｔａ，Ｎｂ，Ｍｏ，Ｗ，Ｉｒ，Ａｇ，Ａｕのそれぞれ１０％以下のうち１種または２種以上合計０．００１～３５％および残部Ｆｅと少量の不純物からなる高耐食性軟磁性合金で，加工および熱処理を施すことによって保磁力Ｈｃが１０Ｏｅ以下，飽和磁束密度Ｂｓが１０ｋＧ以上となり，優れた軟磁気特性が得られる。



【特許請求の範囲】

【請求項１】　原子比にて，Ｐｔ１７～３７％および残部Ｆｅと少量の不純物からなり，保磁力Ｈｃが１０Ｏｅ以下，飽和磁束密度Ｂｓが１０ｋＧ以上を有する耐食性に優れたことを特徴とする軟磁性合金。

【請求項２】　原子比にて，Ｐｔ１７～３７％を主成分とし，副成分としてＣｒ，Ｃｏ，Ｎｉのそれぞれ２５％以下，Ｂ，Ｃ，Ａｌ，Ｓｉ，Ｔｉ，Ｍｎ，Ｃｕ，Ｇｅ，Ｙ，Ｐｄ，Ｔａ，Ｎｂ，Ｍｏ，Ｗ，Ｉｒ，Ａｇ，Ａｕのそれぞれ１０％以下のうち１種または２種以上合計０．００１～３５％および残部Ｆｅと少量の不純物からなり，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する耐食性に優れた軟磁性合金。

【請求項３】　原子比にて，Ｐｔ２６～３６％を主成分とし，副成分としてＣｒを２５％以下，Ｂ，Ｃ，Ｓｉ，Ｔｉ，Ｍｎ，Ｇｅ，Ｙ，Ｔａ，Ｎｂ，Ｍｏ，Ｗ，Ｉｒ，Ａｇのそれぞれ１０％以下のうち１種または２種以上合計０．００１～３５％および残部Ｆｅと少量の不純物からなり，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する生体適合性ならびに耐食性に優れた軟磁性合金。

【請求項４】　請求項１ないし請求項３のいずれか１項に記載の合金を，高周波炉またはアーク炉で溶解し，得られたインゴットを熱間または冷間で加工率３０％以上加工し，これを真空中または非酸化性雰囲気中５００℃以上融点以下の温度で１分間以上１００時間以下均質化熱処理した後０．１℃／秒以上１５００℃／秒以下の速度で冷却することにより，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する耐食性に優れた軟磁性合金の製造方法。

【請求項５】　請求項１ないし請求項３のいずれか１項に記載の合金を，高周波炉またはアーク炉で溶解し，得られたインゴットを熱間または冷間で加工率３０％以上加工し，これを真空中または非酸化性雰囲気中５００℃以上融点以下の温度で１分間以上１００時間以下均質化熱処理した後０．１℃／秒以上１５００℃／秒以下の速度で冷却し，これをさらに真空中または非酸化性雰囲気中４００℃以上融点以下の温度で１分間以上１０００時間以下加熱した後冷却することにより，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する耐食性に優れた軟磁性合金の製造方法。

【請求項６】　請求項３に記載の合金を，精密鋳造法により鋳造し，これを真空中または非酸化性雰囲気中４００℃以上融点以下の温度で１分間以上１０００時間以下加熱した後冷却することにより，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する生体適合性ならびに耐食性に優れた軟磁性合金の製造方法。

【請求項７】　請求項１ないし請求項３のいずれか１項に記載の，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する耐食性に優れた軟磁性合金からなる電磁部品。

【請求項８】　請求項１ないし請求項３のいずれか１項に記載の，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する耐食性に優れた軟磁性合金と永久磁石合金から構成される電磁機器。

【請求項９】　請求項３に記載の，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する生体適合性ならびに耐食性に優れた軟磁性合金からなる医療・健康用具。

【請求項１０】　請求項３に記載の，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する，生体適合性ならびに耐食性に優れた軟磁性合金からなる歯科補綴物のキーパー。

【請求項１１】　請求項３に記載の，保磁力が１０Ｏｅ以下，飽和磁束密度が１０ｋＧ以上を有する，生体適合性ならびに耐食性に優れた軟磁性合金からなる生体内埋込み用機能性部品。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は，酸化性，還元性およびその他の腐食性雰囲気中においても化学的変化を生じ難い耐食性に優れた軟磁性合金に関する。特に，生体毒性に対して高い安全性を有するＰｔとＦｅ元素を主成分とし，副成分は耐食性に優れ，あるいは耐食性を改善する性質を有し，且つ軟磁気特性の向上に有効な元素から構成されるため，医療，歯科ならびに生体適合性機能材料の各分野において安全に使用できる。特に，近年の歯科補綴物の分野における磁石構造体の応用化に際し，吸引磁石を密封保持ならびに維持固定する高耐食性軟磁性合金の開発は重要視されている。

【０００２】

【従来の技術】これまで，生体適合性を有する材料には，オーステナイト系およびフェライト系ステンレス鋼やＴｉおよびＴｉ系合金が知られている。このうち，磁性を有する材料はステンレス鋼のみであり，高濃度のＣｒを含むＳＵＳＸＭ２７，ＳＵＳ４４７Ｊ１，ＳＵＳ３１６Ｌ等が実用に耐えるとされてきた。しかし，これらのステンレス系合金は，食塩水中における自然電極電位が卑であり，またＦｅおよびＣｒの溶出量も多いため，口腔内のような化学的に過酷な環境下におかれた場合の耐食性が問題となる。また，Ｃｒ量が多い組成の合金は軟磁気特性が低下し，溶接性あるいは鋳接性が劣る欠点を有する。

【０００３】

【発明が解決しようとする課題】そこで，本発明者等は，単体では生体毒性に関して極めて高い安全性を示し，且つ高い耐食性を有するＦｅとＰｔの合金に着目し，原子比にてＰｔ１７～３７％を主成分とし，副成分としてＣｒ，Ｃｏ，Ｎｉのそれぞれ２５％以下，Ｂ，Ｃ，Ａｌ，Ｓｉ，Ｔｉ，Ｍｎ，Ｃｕ，Ｇｅ，Ｙ，Ｐｄ，

Ta，Nb，Mo，W，Ir，Ag，Auのそれぞれ10％以下のうち1種または2種以上合計0．001～35％および残部Feと少量の不純物からなる合金の耐食性および軟磁気特性について検討した。

【0004】特に，合金化した場合，アレルギー等の原因となるような生体毒性に対して，高い安全性を有する材料として，原子比にて，Pt26～36％を主成分とし，副成分としてCr25％以下，B，C，Si，Ti，Mn，Ge，Y，Ta，Nb，Mo，W，Ir，Agのそれぞれ10％以下のうち1種または2種以上合計0．001～35％および残部Feと少量の不純物からなる合金は，歯科補綴ならびに医療分野における応用が期待される。

【0005】ところが，原子比にて，26～36％のPtを含む基礎的組成のFe－Pt系2元合金は，生理食塩水中において貴の自然電極電位を示し，且つアノード分極特性も良好であるが，Feが多く溶出する。Fe元素の溶出は毒性を示すものではないが，多量になると錆を誘発し，材料強度の劣化に至る。

【0006】

【課題を解決するための手段】本発明者等は，上記の課題を解決するため，原子比でFe－17～37％Pt系2元合金またはこれを主成分とし，副成分としてCr，CoまたはNiのそれぞれを25％以下，B，C，Al，Si，Ti，Mn，Cu，Ge，Y，Pd，Ta，Nb，Mo，W，Ir，Ag，Auのそれぞれを10％以下のうち1種または2種以上合計0．001～35％と少量の不純物を含み，保磁力が10Oe以下，飽和磁束密度が10kG以上を有する耐食性に優れた軟磁性合金を開発した。

【0007】これらの合金は，従来のステンレス鋼が示す低飽和磁束密度および口腔内環境における低耐食性という欠点を改善し，磁石エネルギーを有効に活用し得る高い軟磁気特性と生体内のように苛酷な条件下でも腐食されない特徴を持っている。さらに，高耐食性と優れた磁石特性を兼備するFe－Pt系磁石合金と組合わせた構造にすることにより，従来の，ステンレス鋼と組合わせた構造にするよりも優れた耐食性が発揮されるため，歯科補綴物のキーパー材料ならびに生体内埋込み用機能性部品として最適であり，また腐食性雰囲気中における電磁部品として使用できる。

【0008】本発明の特徴とするところは以下の通りである。

【0009】第1発明は，原子比にて，Pt17～37％および残部Feと少量の不純物からなり，保磁力Hcが10Oe以下，飽和磁束密度Bsが10kG以上を有する耐食性に優れた軟磁性合金であることを特徴とする。

【0010】第2発明は，原子比にて，Pt17～37％を主成分とし，副成分としてCr，Co，Niのそれぞれ25％以下，B，C，Al，Si，Ti，Mn，Cu，Ge，Y，Pd，Ta，Nb，Mo，W，Ir，Ag，Auのそれぞれ10％以下のうち1種または2種以上合計0．001～35％および残部Feと少量の不純物からなり，保磁力が10Oe以下，飽和磁束密度が10kG以上を有する耐食性に優れた軟磁性合金であることを特徴とする。

【0011】第3発明は，原子比にて，Pt26～36％を主成分とし，副成分としてCrを25％以下，B，C，Si，Ti，Mn，Ge，Y，Ta，Nb，Mo，W，Ir，Agのそれぞれ10％以下のうち1種または2種以上合計0．001～35％および残部Feと少量の不純物からなり，保磁力が10Oe以下，飽和磁束密度が10kG以上を有する生体適合性ならびに耐食性に優れた軟磁性合金であることを特徴とする。

【0012】第4発明は，第1発明ないし第3発明のいずれか1発明の合金を，高周波炉またはアーク炉で溶解し，得られたインゴットを熱間または冷間で加工率30％以上加工し，これを真空中または非酸化性雰囲気中500℃以上融点以下の温度で1分間以上100時間以下加熱した後0．1℃／秒以上1500℃／秒以下の速度で冷却することにより，保磁力が10Oe以下，飽和磁束密度が10kG以上を有する耐食性に優れた軟磁性合金の製造方法に関する。

【0013】第5発明は，第1発明ないし第3発明のいずれか1発明の合金を，高周波炉またはアーク炉で溶解し，得られたインゴットを熱間または冷間で加工率30％以上加工し，これを真空中または非酸化性雰囲気中500℃以上融点以下の温度で1分間以上100時間以下加熱した後0．1℃／秒以上1500℃／秒以下の速度で冷却し，これをさらに真空中または非酸化性雰囲気中400℃以上融点以下の温度で1分間以上1000時間以下加熱した後冷却することにより，保磁力が10Oe以下，飽和磁束密度が10kG以上を有する耐食性に優れた軟磁性合金の製造方法に関する。

【0014】第6発明は，第3発明の合金を，精密鋳造法により鋳造し，これを真空中または非酸化性雰囲気中400℃以上融点以下の温度で1分間以上1000時間以下加熱した後冷却することにより，保磁力が10Oe以下，飽和磁束密度が10kG以上を有する生体適合性ならびに耐食性に優れた軟磁性合金の製造方法に関する。

【0015】第7発明は，第1発明ないし第3発明のいずれか1発明の合金を，第4発明ないし第6発明のいずれか1発明の方法によって製造した，保磁力が10Oe以下，飽和磁束密度が10kG以上を有する耐食性に優れた軟磁性合金からなる電磁部品であることを特徴とする。

【0016】第8発明は，第1発明ないし第3発明のいずれか1発明の合金を，第4発明ないし第6発明のいず

れか１発明の方法によって製造した，保磁力が１００ｅ以下，飽和磁束密度が１０ｋＧ以上を有する耐食性に優れた軟磁性合金と，永久磁石合金から構成される電磁機器であることを特徴とする。

【００１７】第９発明は，第３発明の合金を，第４発明ないし第６発明のいずれかの方法によって製造した，保磁力が１００ｅ以下，飽和磁束密度が１０ｋＧ以上を有する耐食性に優れた軟磁性合金からなる医療・健康用具であることを特徴とする。

【００１８】第１０発明は，第３発明の合金を，第４発明ないし第６発明のいずれかの方法によって製造した，保磁力が１００ｅ以下，飽和磁束密度が１０ｋＧ以上を有する，耐食性に優れた軟磁性合金からなる歯科補綴物のキーパーであることを特徴とする。

【００１９】第１１発明は，第３発明の合金を，第４発明ないし第５発明のいずれかの方法によって製造した，保磁力が１００ｅ以下，飽和磁束密度が１０ｋＧ以上を有する，耐食性に優れた軟磁性合金からなる生体内埋込み用機能性部品であることを特徴とする。

【００２０】

【作用】以下に本発明の構成を説明する。耐食性軟磁性合金の成分は，原子比にてＰｔ１７～３７％を主成分とし，副成分としてＣｒ，Ｃｏ，Ｎｉのそれぞれ２５％以下，Ｂ，Ｃ，Ａｌ，Ｓｉ，Ｔｉ，Ｍｎ，Ｃｕ，Ｇｅ，Ｙ，Ｐｄ，Ｔａ，Ｎｂ，Ｍｏ，Ｗ，Ｉｒ，Ａｇ，Ａｕのそれぞれ１０％以下のうち１種または２種以上合計０．００１～３５％および残部Ｆｅと少量の不純物からなる。

【００２１】特に，生体毒性に対して高い安全性を有する材料としては，原子比にて，Ｐｔ２６～３６％を主成分とし，副成分としてＣｒ２５％以下，Ｂ，Ｃ，Ｓｉ，Ｔｉ，Ｍｎ，Ｇｅ，Ｙ，Ｔａ，Ｎｂ，Ｍｏ，Ｗ，Ｉｒ，Ａｇのそれぞれ１０％以下のうち１種または２種以上合計０．００１～３５％および残部Ｆｅと少量の不純物からなる。

【００２２】これらの合金を高周波炉で溶解後，金型に鋳造して冷間および熱間で加工率３０％以上加工するか，あるいは複雑形状を有する歯科補綴物や生体内埋込み用インプラント等は精密鋳造法によって，要求される形態を直接作製する。本系合金は，鋳造状態でも熱処理によって軟磁気特性を示すが，冷間加工あるいは熱間加工と熱処理との組合わせにより，集合組織あるいは再結晶組織を得ることで耐食性および軟磁気特性がさらに向上する。

【００２３】軟磁性合金の組成範囲を上述のように限定した理由は，原子比にてＰｔ１７％未満では室温において所期の磁気特性が得られなくなる。また，Ｐｔ３７％以上では均質化熱処理後急冷しても磁気特性が不安定で，大きな保磁力を発生し易く，軟磁気特性が失われてしまうからである。

【００２４】生体適合性を重視した場合，Ｐｔ２６％未満では生理食塩水中におけるＦｅの溶出量が増加し，Ｐｔ３７％未満であれば上記熱処理後大気中放冷によっても確実に均質化相を得ることができる。且つ，冷間圧延やしぼり等の強加工が可能である。

【００２５】次に，副成分としてＣｒ，Ｃｏ，Ｎｉのそれぞれ２５％以下とした理由は，Ｃｒ量を増すと鋳造性ならびに加工性が劣化して加工が難しくなり，残留磁束密度も減少して所期の軟磁気特性が得られなくなるので，２５％以下とした。また，ＣｏおよびＮｉは飽和磁束密度を上昇させるが，生体に対してはアレルギーを起こし易い元素であることから，生体適合性軟磁性合金から除いた。

【００２６】さらに，Ｂ，Ｃ，Ａｌ，Ｓｉ，Ｔｉ，Ｍｎ，Ｃｕ，Ｇｅ，Ｙ，Ｐｄ，Ｔａ，Ｎｂ，Ｍｏ，Ｗ，Ｉｒ，Ａｇ，Ａｕそれぞれの添加量を１０％以上とすると，合金の鋳造性低下，脆性増加を招き，磁気特性が劣化する等の悪影響を及ぼすため製造が困難になったり軟磁気特性が失われるからである。また，生体適合性軟磁性合金を製造するためには，アルツハイマー病に関与するとされるＡｌ，およびアレルギーを起こす率が高いとされるＣｕ，Ｐｄ，Ａｕ元素を除いた。

【００２７】副成分のＣｒ，Ｃｏ，ＮｉとＢ，Ｃ，Ａｌ，Ｓｉ，Ｔｉ，Ｍｎ，Ｃｕ，Ｇｅ，Ｙ，Ｐｄ，Ｔａ，Ｎｂ，Ｍｏ，Ｗ，Ｉｒ，Ａｇ，Ａｕのうち１種または２種以上合計０．００１％以下では添加効果が得られないからであり，添加量が両者をあわせて３５％以上になると，合金の鋳造性の低下，脆性の増加，磁気特性の劣化および本来Ｆｅ－Ｐｔ系合金が有する耐食性の喪失等多くの悪影響が顕著になるためである。

【００２８】軟磁性合金の製造方法に関し，インゴットに加工率３０％以上加工を加えるのは，鋳造組織をこわして緻密な構造とし，５００℃以上融点以下の温度で均質化熱処理後，４００℃以上融点以下の温度で時効処理を施すと，微細結晶組織となり，磁気特性の向上がはかれることによる。

【００２９】機械加工による製造が困難な形態の場合は，精密鋳造法を含むロストワックス法等によって直接，所望形状を作製し，これに４００℃以上融点以下の温度で熱処理後，適切な冷却速度で冷却することによって軟磁気特性を得ることができる。

【００３０】図１および図２は代表的な合金のアノード分極曲線を示し，また図３および図４にはＦｅ－Ｐｔ系２元合金を急冷処理後６００℃の温度に保持した場合の保磁力Ｈｃと飽和磁束密度Ｂｓの時効処理時間に対する変化を示した。

【００３１】表１には代表的な合金を，３７℃に保った生理食塩水中に７日間浸積した後，溶出元素の量を測定した結果を示した。また表２から表５には熱処理を変えた場合の各種Ｆｅ－Ｐｔ系合金の保磁力Ｈｃと飽和磁束

密度Ｂｓの値を示した。

【００３２】

＊【表１】

＊

（単位 μg/cm²）

	検出限界 μg/cm²	Fe-33%Pt	Fe-30%Pt	Fe-29%Pt-1%Nb	Fe-29%Pt-5%Cr-0.5%Mo	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb	Fe-17%Pt-20%Cr-3%Nb
Fe	*0.4*	3.2	3.4	5.0	4.1	4.2	2.9	2.6
Pt	*0.9*	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Cr	*0.03*	—	—	—	< DL	0.04	0.05	0.05
Nb	*4.6*	—	—	< DL	—	< DL	< DL	< DL
Mo	*0.1*	—	—	—	0.2	—	—	—
Si	*0.02*	—	—	—	—	0.02	—	—

※ ＜DL ： 検出限界以下

【００３３】

※ ※【表２】

冷間加工＋1000 ℃, 5時間＋大気中冷却

	Fe-33%Pt	Fe-30%Pt	Fe-29%P-1%Nb	Fe-29%Pt-5%Cr-0.5%Mo	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb	Fe-17%Pt-20%Cr-3%Nb
保磁力 Hc/Oe	2.1	1.6	1.0	1.2	2.5	3.4	4.0
飽和磁束密度 B_S/kG	14.1	14.3	14.5	14.2	13.2	12.0	10.4

【００３４】

★ ★【表３】

冷間加工＋1000 ℃, 5時間＋炉中冷却

	Fe-33%Pt	Fe-30%Pt	Fe-29%Pt-1%Nb	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb
保磁力 Hc/Oe	8.0	4.0	3.1	3.6	3.8
飽和磁束密度 B_S/kG	13.5	13.1	13.6	12.2	10.7

【００３５】

☆ ☆【表４】

冷間加工＋1200℃, 1時間＋氷水中冷却＋600 ℃, 5 時間＋大気中冷却

	Fe-33%Pt	Fe-29%Pt-1%Nb	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb	Fe-17%Pt-20% Cr-3%Nb
保磁力 Hc/Oe	8.2	5.0	6.1	4.5	7.7
飽和磁束密度 B_S/kG	14.1	13.9	12.2	11.0	10.3

【００３６】

◆ ◆【表５】

精密鋳造材＋1000℃，5時間＋大気中冷却＋600℃，10時間＋大気中冷却

	Fe-33%Pt	Fe-29%Pt-1%Nb	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb	Fe-17%Pt-20%Cr-3%Nb
保磁力 Hc/Oe	9.2	4.2	5.5	5.7	8.6
飽和磁束密度 B_S/kG	13.1	13.3	12.0	11.4	10.2

【0037】
【実施例】以下，上記の各特性を示す合金を用いた実施例に基づいて本発明を説明する。
〔実施例1〕高周波溶解炉により，真空中でＰｔ３３％，残部Ｆｅと少量の不純物からなる２元合金を溶解し，金型鋳造によって外径８ｍｍ×長さ６０ｍｍのインゴットを得た。これを冷間スエージングにより減面率８５％まで加工し，外径約３ｍｍの丸棒を得た。これより長さ３０ｍｍを切り出し，真空中において１０００℃の温度で５時間加熱した後大気中冷却した。０．９％生理食塩水中におけるアノード分極特性から，この合金の自然電極電位は０．２ＶｖｓＮＨＥと正で高い値が得られ，孔食電位も１．３ＶｖｓＮＨＥのように良好な値であった。また，保磁力Ｈｃは２．１Ｏｅ，飽和磁束密度は１４．１ｋＧであり，これらは，耐食性ステンレス鋼と比較して，軟磁気特性は多少劣るものの耐食性は非常に良好であった。同一断面を有する，最大エネルギー積が１５ＭＧＯｅのＦｅ−Ｐｔ系磁石合金との間に作用する吸引力は，長さ方向では８１０ｇｆに及び，直径方向に並列させた場合は４６０ｇｆであった。前者は小型電磁弁等に用いた場合実用可能な吸引力である。
【００３８】〔実施例２〕高周波溶解炉により，真空中で，原子比にてＰｔ２９％，Ｎｂ１％および残部Ｆｅと少量の不純物からなる合金を溶解し，金型鋳造によって外径８ｍｍ×長さ６０ｍｍのインゴットを得た。これから長さ２ｍｍの部分を切り出し，１０００℃の温度で５時間の均質化処理後炉中冷却した。この円板状試料の表面を鏡面研摩した後，１５ＭＧＯｅの最大エネルギー積を有するＦｅ−Ｐｔ系磁石合金との間に作用する吸引力を測定したところ，実用上充分な強度の５６０ｇｆが得られた。また，両者を組合わせた状態で０．９％生理食塩水中に７日間浸漬したところ，Ｆｅが５．０μｇ／ｃｍ^{2}溶出したが，ＮｂおよびＰｔの溶出量は検出限界以下の微量であった。薄手の円板形状は磁気チャック等の電磁部品と同等の寸法を有し，腐食ガス等の流路において実用可能な吸引力である。
【００３９】〔実施例３〕高周波溶解炉により，真空中でＰｔ２８％，Ｃｒ７％，Ｎｂ１．５％，Ｓｉ０．５％および残部Ｆｅと少量の不純物からなる合金を溶解し，金型鋳造によって，外径６ｍｍ×長さ８０ｍｍのインゴットを得た。インゴットを冷間で鍛造とロール圧延により加工率９０％以上加工して厚さ０．７ｍｍ×幅８ｍｍの板状に整形し，これから長さ２０ｍｍの部分を切り出した。これを１０００℃の温度で２４時間均質化熱処理し，水中に投入後，さらに真空中において６００℃の温度で５時間加熱後大気中冷却した。この薄板状試料の表面を研摩して平滑化後，同一面積の最大エネルギー積１５ＭＧＯｅを有するＦｅ−Ｐｔ系磁石合金と接触させ，０．９％生理食塩水中に７日間浸漬したところ，Ｆｅが４．６μｇ／ｃｍ^2，Ｃｒが０．０５μｇ／ｃｍ^2，Ｓｉが０．０２μｇ／ｃｍ^{2}溶出し，ＮｂおよびＰｔは検出限界値以下であった。この薄板は，口唇閉鎖等の目的で生体内埋め込みを想定した寸法の例であり，この後プレス等によって所望の形態に整形する。厚さ方向に着磁し，両者を組み合わせて整合させた状態での吸引力は４３０ｇｆであり，実用上有効な値であった。
【００４０】〔実施例４〕真空雰囲気中において高周波溶解炉とＡｒガス圧迫鋳造法を組合わせた精密鋳造により，Ｐｔ１７％，Ｃｒ２０％，Ｎｂ３％および残部Ｆｅと少量の不純物からなる合金を，歯科補綴物の内冠の形態に鋳造し，真空中において１０００℃の温度で５間加熱後大気中冷却した。同様の鋳造方法によって作製した１５ＭＧＯｅの最大エネルギー積を有するＦｅ−Ｐｔ系磁石合金からなる外冠と組合わせ，０．９％生理食塩水中に７日間浸漬したところ，Ｆｅが３．９μｇ／ｃｍ^2，Ｃｒが０．０３μｇ／ｃｍ^{2}溶出し，ＮｂおよびＰｔは検出限界以下であった。これは，歯科分野において通常観測される値以下の小さな溶出量である。また，接触面を整合させた両者間に作用する吸引力は，６１０ｇｆであり，実用上十分な吸引力であった。
【００４１】
【発明の効果】従来用いられてきた磁性ステンレス鋼によるヨーク，キーパー，インプラント等はいずれも構成元素のＦｅ，Ｃｒの溶出量が多く，特に，人体に対してアレルギーを生じさせると考えられているＮｉの溶出が懸念されている。本発明に関わる合金は，生体毒性に対して極めて高い安全性を有するＰｔとＦｅ元素を主成分とし，副成分は耐食性に優れ，且つ軟磁気特性の向上に有効な元素から構成される。従ってこれらの効果により，生体表面や口腔内で安全に使用できる生体適合性に優れ，且つ耐食性の高い軟磁性合金が得られ，市販の磁性アタッチメントと組合わせた場合は勿論のこと，Ｆｅ

－Ｐｔ系磁石との組合わせ構造とした場合には，特に優れた効果を発揮し，生体内における磁石の積極的な活用を可能とする。他に，磁気遮蔽効果，磁気誘導効果等，軟磁気特性を有する材料の一般的な特性を活かした応用例えば，電磁部品，電磁機器，医療・健康用具，歯科補綴物のキーパーならびに生体内埋込み用機能性部品に適しているので，工業的にも非常に有用な軟磁性合金である。

【図面の簡単な説明】

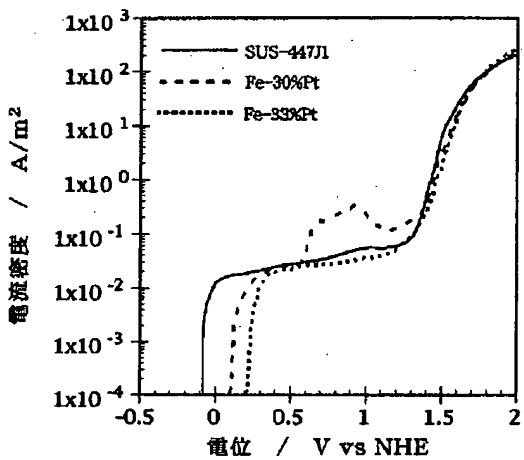
【図1】図1はＦｅ－３０％Ｐｔ，Ｆｅ－３３％Ｐｔ両合金のアノード分極曲線であり，比較のためＳＵＳ４４７Ｊ１についても示した。

【図2】図2はＦｅ－２９％Ｐｔ－１％Ｎｂ，Ｆｅ－２８％Ｐｔ－７％Ｃｒ－１．５％Ｎｂ－０．５％Ｓｉ，Ｆｅ－２５％Ｐｔ－１０％Ｃｒ－０．５％Ｎｂ合金のアノード分極曲線を示す。

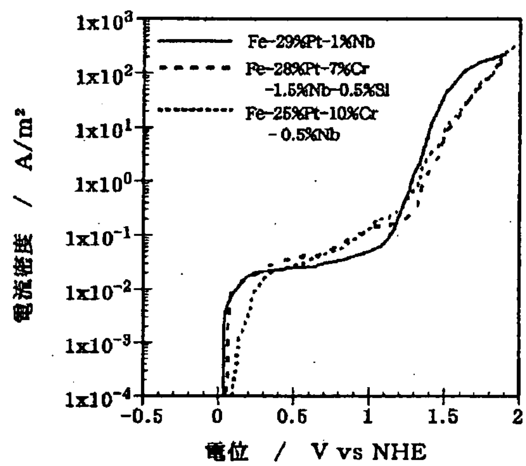
【図3】図3はＦｅ－２６％Ｐｔ，Ｆｅ－３０％Ｐｔ，Ｆｅ－３３％ＰｔおよびＦｅ－３６％Ｐｔ合金の保磁力Ｈｃの時効処理時間依存性を示している。

【図4】図4はＦｅ－２６％Ｐｔ，Ｆｅ－３０％Ｐｔ，Ｆｅ－３３％ＰｔおよびＦｅ－３６％Ｐｔ合金の飽和磁束密度Ｂｓの時効処理時間依存性を示している。

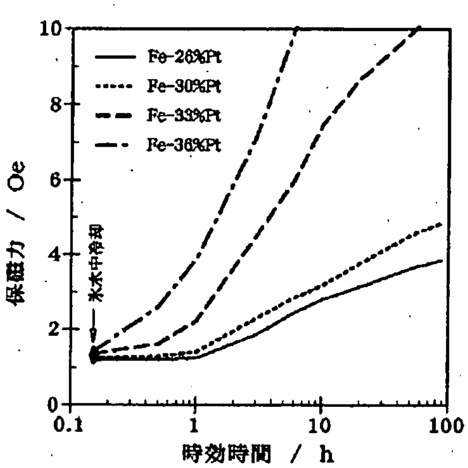
【図1】



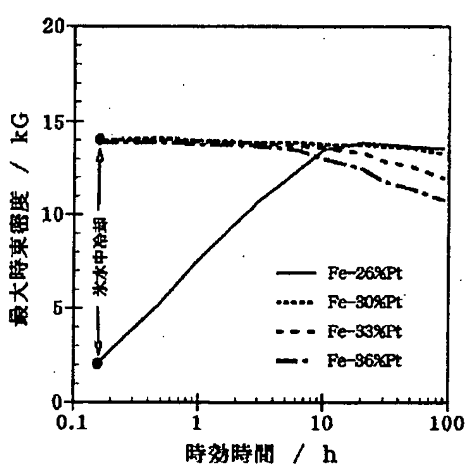
【図2】



【図3】



【図4】



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(71)Applicant : RES INST ELECTRIC MAGNETIC ALLOYS

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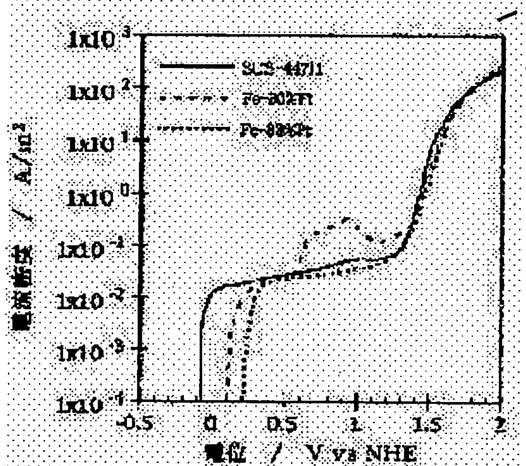
(54) SOFT MAGNETIC ALLOY EXCELLENT IN CORROSION RESISTANCE

17-37% Pt
-25% Cr Co, Ni
-35% Mo
bal Fe

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a soft magnetic alloy which is hardly changed chemically even if being exposed to severe environments such as the insides of the living body and oral cavity and excellent in corrosion resistance, particularly a soft magnetic alloy exhibiting most excellent corrosion resistance by making a structure in the combination with an Fe-Pt permanent magnet alloy.

SOLUTION: This alloy is a high corrosion resistance soft magnetic alloy contg., by atomic ratio, 17 to 37% Pt as the main component, contg. 0.001 to 35% in total one or more kinds among Cr, Co and Ni respectively by ≤25% and B, C, Al, Si, Ti, Mn, Cu, Ge, Y, Pd, Ta, Nb, Mo, W, Ir, Ag and Au respectively by ≤10% as assistant components, and the balance Fe with a small amt. of impurities, and by executing working and heat treatment, its coercive force Hc is made to be ≤10 Oe, its saturation magnetic flux density Bs is made to be ≥10 kG, and excellent soft magnetic properties can be obtd.



LEGAL STATUS

CLAIMS

[Claim(s)]
[Claim 1] The soft magnetism alloy with which it consists of 17 - 37% of Pt(s), the remainder Fe, and a small amount of impurity in an atomic ratio, and coercive force HC is characterized by excelling in 10 or less Oes and the corrosion resistance in which saturation magnetic flux density BS has 10 or more kGs.
[Claim 2] In an atomic ratio, 17 - 37% of Pt(s) is used as a principal component. As an accessory constituent While of 10% or less, 25% or less of each of Cr, Co, and nickel, and B, C, aluminum, Si, Ti, Mn, Cu, germanium, Y, Pd, Ta, Nb, Mo, W, Ir, Ag and Au, respectively One sort or two or more sorts of a total of 0.001 - 35% And the soft magnetism alloy excellent in the corrosion resistance in which it becomes from Remainder Fe and a small amount of impurity, and coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.
[Claim 3] In an atomic ratio, 26 - 36% of Pt(s) is used as a principal component. As an accessory constituent Cr It consists of one sort or two or more sorts of a total of 0.001 - 35% and the remainder Fe, and a small amount of impurity 25% or less among 10% or less of each of B, C, Si, Ti, Mn, germanium, Y, Ta, Nb, Mo, W, Ir, and Ag. Ten or less Oes and saturation magnetic flux density 10 or more kGs [coercive force] The soft magnetism alloy excellent in the biocompatibility and corrosion resistance which it has.
[Claim 4] Claim 1 The alloy of a publication in any 1 term of claim 3 Or a high-frequency furnace Dissolve with an arc furnace and or the obtained ingot It is processed 30% or more of working ratio between heat or between the colds. This By cooling a second at 0.1 degrees C /or more 1500 degrees C/second or less in rate, after carrying out homogenization heat treatment more than for 1 minute for 100 or less hours at the temperature in a vacuum or below 500-degree-C or more melting point in a non-oxidizing atmosphere The manufacture approach of a soft magnetism alloy excellent in the corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.
[Claim 5] Claim 1 The alloy of a publication in any 1 term of claim 3 Or a high-frequency furnace Dissolve with an arc furnace and or the obtained ingot It is processed 30% or more of working ratio between heat or between the colds. This The inside of a vacuum Or after carrying out homogenization heat treatment more than for 1 minute for 100 or less hours at the temperature below 500-degree-C or more melting point in a non-oxidizing atmosphere, it cools a second at 0.1 degrees C /or more 1500 degrees C/second or less in rate. The manufacture approach of a soft magnetism alloy excellent in the corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs by cooling after heating this more than for 1 minute further for 1000 or less hours at the temperature in a vacuum or below 400-degree-C or more melting point in a non-oxidizing atmosphere.
[Claim 6] The manufacture approach of a soft magnetism alloy excellent in the biocompatibility and corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs by cooling after casting an alloy according to claim 3 by precision casting and heating this more than for 1 minute for 1000 or less hours at the temperature in a vacuum or below 400-degree-

C or more melting point in a non-oxidizing atmosphere.
[Claim 7] The electromagnetic component which consists of a soft magnetism alloy excellent in the corrosion resistance in which the coercive force of a publication has 10 or less Oes in any 1 term of claim 1 thru/or claim 3, and saturation magnetic flux density has 10 or more kGs.
[Claim 8] the electromagnetism which consists of a soft magnetism alloy excellent in the corrosion resistance in which the coercive force of a publication has 10 or less Oes in any 1 term of claim 1 thru/or claim 3, and saturation magnetic flux density has 10 or more kGs, and a permanent magnet alloy -- a device.
[Claim 9] The medicine and the health tools which consist of a soft magnetism alloy excellent in the biocompatibility and corrosion resistance in which coercive force according to claim 3 has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.
[Claim 10] The keeper of orthoprosthesis who consists of a soft magnetism alloy excellent in the biocompatibility and corrosion resistance in which coercive force according to claim 3 has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.
[Claim 11] The functional components for pads in the living body which consist of a soft magnetism alloy excellent in the biocompatibility and corrosion resistance in which coercive force according to claim 3 has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the soft magnetism alloy excellent in the corrosion resistance which cannot produce chemical change easily in an oxidizing quality, reducibility, and other corrosive ambient atmospheres. Since it has the property to use as a principal component Pt which has high safety to living body toxicity especially, and Fe element, and for an accessory constituent to be excellent in corrosion resistance, or to improve corrosion resistance and consists of elements effective in improvement in soft magnetic characteristics, in each field of medicine, dentistry, and a living body adaptation reproductive function ingredient, it can be used for insurance. Importance is attached to especially development of the high corrosion resistance soft magnetism alloy which holds [seal-] and fixes [maintenance-] a suction magnet on the occasion of application-izing of the magnet structure in the field of orthoprosthesis in recent years.
[0002]
[Description of the Prior Art] Until now, austenite and ferritic stainless steel, and Ti and Ti system alloy are known by the ingredient which has biocompatibility. Among these, the ingredient which has magnetism is only stainless steel and it has been supposed that SUSXM27, SUS447J1, SUS316L, etc. containing high-concentration Cr are equal to practical use of an ingredient. However, the natural electrode potential [alloys / these / stainless steel system] in brine is **, and since there are also many elution volumes of Fe and Cr, the corrosion resistance at the time of [like / in the oral cavity] setting under a harsh environment chemically poses a problem. Moreover, soft magnetic characteristics fall and the alloy of the presentation with many amounts of Cr(s) has the fault which is inferior in weldability or ******.
[0003]
[Problem(s) to be Solved by the Invention] this invention person etc. uses 17 - 37% of Pt(s) as a principal component in an atomic ratio paying attention to the alloy of Fe and Pt which shows very high safety and has high corrosion resistance about living body toxicity alone. Then, as an accessory constituent While of 10% or less, 25% or less of each of Cr, Co, and nickel, and B, C, aluminum, Si, Ti, Mn, Cu, germanium, Y, Pd, Ta, Nb, Mo, W, Ir, Ag and Au, respectively One sort or two or more sorts of a total of 0.001 - 35% And the corrosion resistance of an alloy and soft magnetic characteristics which consist of the remainder Fe and a small amount of impurity were examined.
[0004] As opposed to living body toxicity which becomes causes, such as allergy, when it alloys especially As an ingredient which has high safety, 26 - 36% of Pt(s) is used as a principal component in an atomic ratio. As an accessory constituent Less than [Cr25%], B, C, Si, Ti, Mn, germanium, Y, Ta, Application [in / in the alloy of Nb, Mo, W, Ir, and Ag which consists of one sort or two or more sorts of a total of 0.001 - 35% and the remainder Fe, and a small amount of impurity, respectively while of 10% or less / dental prosthesis and the medical field] is expected.
[0005] However, although the Fe-Pt system binary system alloy of the fundamental presentation which contains 26 - 36% of Pt in an atomic ratio shows the natural electrode potential of ** in a physiological

saline and its anodic polarization property is also good, Fe is eluted mostly. Although the elution of Fe element does not show toxicity, if it becomes abundant, it will induce rust and will result in degradation of material strength.
[0006]
[Means for Solving the Problem] In order that this invention person etc. may solve the above-mentioned technical problem, Pt system binary system alloy or this is made into a principal component Fe-17 to 37% by the atomic ratio. As an accessory constituent Each of Cr, Co, or nickel 25% or less, while of 10% or less, one sort, or two or more sort a total of 0.001 - 35% and a small amount of impurity is included for each of B, C, aluminum, Si, Ti, Mn, Cu, germanium, Y, Pd, Ta, Nb, Mo, W, Ir, Ag, and Au. Coercive force Ten or less Oes, Saturation magnetic flux density developed the soft magnetism alloy excellent in the corrosion resistance which has 10 or more kGs.
[0007] These alloys improve the fault of the low corrosion resistance in the hyposaturation flux density which the conventional stainless steel shows, and the oral cavity milieu interne, and have the high soft magnetic characteristics which can utilize magnet energy effectively, and the description which is not corroded under severe conditions like in the living body. Furthermore, since the corrosion resistance which was excellent rather than it made it the structure combined with the conventional stainless steel by making it the structure combined with the Fe-Pt system magnet alloy which combines high corrosion resistance and the outstanding magnet property is demonstrated, it is the optimal as the keeper ingredient of orthoprosthesis, and functional components for pads in the living body, and can be used as an electromagnetic component in a corrosive ambient atmosphere.
[0008] The place by which it is characterized [of this invention] is as follows.
[0009] The 1st invention consists of 17 - 37% of Pt(s), the remainder Fe, and a small amount of impurity in an atomic ratio, and is characterized by coercive force Hc being the soft magnetism alloy excellent in 10 or less Oes and the corrosion resistance in which saturation magnetic flux density BS has 10 or more kGs.
[0010] The 2nd invention uses 17 - 37% of Pt(s) as a principal component in an atomic ratio. As an accessory constituent While of 10% or less, 25% or less of each of Cr, Co, and nickel, and B, C, aluminum, Si, Ti, Mn, Cu, germanium, Y, Pd, Ta, Nb, Mo, W, Ir, Ag and Au, respectively One sort or two or more sorts of a total of 0.001 - 35% And it consists of the remainder Fe and a small amount of impurity, and is characterized by being the soft magnetism alloy excellent in the corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.
[0011] The 3rd invention uses 26 - 36% of Pt(s) as a principal component in an atomic ratio. As an accessory constituent Cr It consists of one sort or two or more sorts of a total of 0.001 - 35% and the remainder Fe, and a small amount of impurity 25% or less among 10% or less of each of B, C, Si, Ti, Mn, germanium, Y, Ta, Nb, Mo, W, Ir, and Ag. Ten or less Oes and saturation magnetic flux density 10 or more kGs [coercive force] It is characterized by being the soft magnetism alloy excellent in the biocompatibility and corrosion resistance which it has.
[0012] The 4th invention The 1st invention The alloy of any 1 invention of the 3rd invention Or a high-frequency furnace Dissolve with an arc furnace and or the obtained ingot By cooling a second at 0.1 degrees C /or more 1500 degrees C/second or less in rate, after processing it 30% or more of working ratio between heat or between the colds and heating this more than for 1 minute for 100 or less hours at the temperature in a vacuum or below 500-degree-C or more melting point in a non-oxidizing atmosphere It is related with the manufacture approach of a soft magnetism alloy excellent in the corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.
[0013] The 5th invention The 1st invention The alloy of any 1 invention of the 3rd invention Or a high-frequency furnace Dissolve with an arc furnace and or the obtained ingot It is processed 30% or more of working ratio between heat or between the colds. This The inside of a vacuum Or after heating more than for 1 minute for 100 or less hours at the temperature below 500-degree-C or more melting point in a non-oxidizing atmosphere, it cools a second at 0.1 degrees C /or more 1500 degrees C/second or less in rate. By cooling, after heating this more than for 1 minute further for 1000 or less hours at the

temperature in a vacuum or below 400-degree-C or more melting point in a non-oxidizing atmosphere, it is related with the manufacture approach of a soft magnetism alloy excellent in the corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.
[0014] The 6th invention casts the alloy of the 3rd invention by precision casting, and relates to the manufacture approach of a soft magnetism alloy excellent in the biocompatibility and corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs by cooling, after heating this more than for 1 minute for 1000 or less hours at the temperature in a vacuum or below 400-degree-C or more melting point in a non-oxidizing atmosphere.
[0015] The 7th invention is characterized by being the electromagnetic component which consists of a soft magnetism alloy excellent in the corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs which manufactured the alloy of any 1 invention of the 1st invention thru/or the 3rd invention by the approach of any 1 invention the 4th invention thru/or the 6th invention.
[0016] the electromagnetism which consists of a soft magnetism alloy excellent in the corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs into which the 8th invention manufactured the alloy of any 1 invention of the 1st invention thru/or the 3rd invention by the approach of any 1 invention the 4th invention thru/or the 6th invention, and a permanent magnet alloy -- it is characterized by being a device.
[0017] The 9th invention is characterized by being the medicine and the health tools which consist of a soft magnetism alloy excellent in the corrosion resistance in which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs which manufactured the alloy of the 3rd invention by the approach of the 4th invention thru/or the 6th invention either.
[0018] The 10th invention is characterized by being the keeper of orthoprosthesis who manufactured the alloy of the 3rd invention by the approach of the 4th invention thru/or the 6th invention either and who consists of a soft magnetism alloy excellent in corrosion resistance with which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.
[0019] The 11th invention is characterized by being the functional components for pads in the living body which manufactured the alloy of the 3rd invention by the approach of the 4th invention thru/or the 5th invention either and which consist of a soft magnetism alloy excellent in corrosion resistance with which coercive force has 10 or less Oes, and saturation magnetic flux density has 10 or more kGs.
[0020]
[Function] The configuration of this invention is explained below. the component of a corrosion-resistant soft magnetism alloy -- an atomic ratio -- 17 - 37% of Pt(s) -- a principal component -- carrying out -- as an accessory constituent -- Cr, Co, and nickel -- respectively -- 25% or less, and B, C, aluminum, Si, Ti, Mn, Cu, germanium, Y, Pd, Ta, Nb, Mo, W, Ir, Ag and Au -- while of 10% or less, it consists of one sort or two or more sorts of a total of 0.001 - 35% and the remainder Fe, and a small amount of impurity, respectively.
[0021] As an ingredient which has high safety to living body toxicity especially, in an atomic ratio, 26 - 36% of Pt(s) is used as a principal component, and it consists of one sort or two or more sorts of a total of 0.001 - 35% and the remainder Fe, and a small amount of impurity as an accessory constituent among 10% or less of each of less than [Cr25%], and B, C, Si, Ti, Mn, germanium, Y, Ta, Nb, Mo, W, Ir and Ag.
[0022] Orthoprosthesis, implant for pads in the living body, etc. which cast these alloys in a high-frequency furnace after the dissolution and to metal mold, and process them 30% or more of working ratio between the colds and between heat, or have a complicated configuration produce the gestalt demanded directly by precision casting. Although this system alloy shows soft magnetic characteristics by heat treatment also in the state of casting, corrosion resistance and its soft magnetic characteristics improve further by obtaining texture or recrystallized structure with the combination of cold working or hot working, and heat treatment.
[0023] As for the reason which limited the presentation range of a soft magnetism alloy as mentioned above, in a room temperature, expected magnetic properties are no longer acquired less than [Pt17%]

in an atomic ratio. Moreover, it is because magnetic properties will be unstable, it will be easy to generate big coercive force and soft magnetic characteristics will be lost more than at Pt37%, even if it quenches after homogenization heat treatment.
[0024] When biocompatibility is thought as important, less than [Pt26%], the elution volume of Fe in a physiological saline increases, and if it is less than [Pt37%], a homogenization phase can be certainly obtained also by the above-mentioned radiationnal cooling among after [heat treatment] atmospheric air. and cold rolling -- extracting -- etc. -- strong processing is possible.
[0025] Next, as an accessory constituent, since fluidity and workability deteriorated, processing became difficult, the residual magnetic flux density also decreased and expected soft magnetic characteristics were no longer obtained when the amount of Cr(s) was increased, the reason of Cr, Co, and nickel made into 25% or less, respectively was made into 25% or less. Moreover, although saturation magnetic flux density was raised, since Co and nickel were elements which are easy to start allergy to a living body, they were removed from the biocompatibility soft magnetism alloy.
[0026] Furthermore, it is because manufacture will become difficult or soft magnetic characteristics will be lost, in order to do the bad influence of causing the fluidity fall of an alloy, and a brittle increment and magnetic properties deteriorating if the addition of B, C, aluminum, Si, Ti, Mn, Cu, germanium, Y, Pd, Ta, Nb, Mo, W, Ir, Ag, and each Au is made into 10% or more. Moreover, in order to manufacture a biocompatibility soft magnetism alloy, Cu and Pd which are made high [aluminum it is supposed that is participated in an Alzheimer disease and the rate which starts allergy], and Au element were removed.
[0027] It is because the addition effectiveness is not acquired at one sort or two or more sorts of a total of 0.001% or less Cr, Co and nickel of an accessory constituent, and of B, C, aluminum, Si, Ti, Mn, Cu, germanium, Y, Pd, Ta, Nb, Mo, W, Ir, Ag, and Au. An addition both When it unites and becomes 35% or more, it is because many bad influences, such as corrosion resistance loss which a Fe-Pt system alloy has degradation and originally [of the fall of the fluidity of an alloy a brittle increment, and magnetic properties], become remarkable.
[0028] If cast structure is broken, it considers as precise structure and aging treatment is performed with the temperature below 500-degree-C or more melting point at the temperature after homogenization heat treatment and below 400-degree-C or more melting point, it will become a fine crystal organization to add 30% or more processing of working ratio to an ingot about the manufacture approach of a soft magnetism alloy, and it will be because improvement in magnetic properties can be aimed at.
[0029] When manufacture by machining is a difficult gestalt, a request configuration can be directly produced with the lost wax process containing precision casting etc., and soft magnetic characteristics can be obtained by cooling after heat treatment at the temperature below 400-degree-C or more melting point to this at a suitable cooling rate.
[0030] Drawing 1 and drawing 2 showed the anode polarization curve of a typical alloy, and showed the change to the aging treatment time amount of the coercive force HC at the time of holding a Fe-Pt system binary system alloy in temperature of 600 degrees C after quenching processing, and saturation magnetic flux density BS to drawing 3 and drawing 4.
[0031] After dipping a typical alloy for seven days into the physiological saline kept at 37 degrees C, the result of having measured the amount of an elution element was shown in Table 1. Moreover, the coercive force HC of the various Fe-Pt system alloys at the time of changing heat treatment and the value of saturation magnetic flux density BS were shown in Table 5 from Table 2.
[0032]
[Table 1]

57.3% Pt
3.8% Cr ✓

1 2 3 4 5 6 7

(単位 μg/cm²)

	検出限界 μg/cm²	Fe-33%Pt	Fe-30%Pt	Fe-29%Pt-1%Nb	Fe-29%Pt-5%Cr-0.5%Mo	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb	Fe-17%Pt-20%Cr-3%Nb
Fe	0.4	3.2	3.4	5.0	4.1	4.2	2.9	2.6
Pt	0.9	< DL	< DL	< DL	< DL	< DL	< DL	< DL
Cr	0.03	—	—	—	< DL	0.04	0.05	0.05
Nb	4.6	—	—	< DL	—	< DL	< DL	< DL
Mo	0.1	—	—	—	0.2	—	—	—
Si	0.02	—	—	—	—	0.02	—	—

※ < DL ; 検出限界以下

Not >50% Pt

53.9% Pt
5.8% Cr
39.8% Fe
.5% Nb ✓

55.3% Pt
2.5% Cr
41.7% Fe
.5% Mo

[0033]
[Table 2]
冷間加工＋1000 ℃, 5時間＋大気中冷却

	Fe-33%Pt	Fe-30%Pt	Fe-29%P-1%Nb	Fe-29%Pt-5%Cr-0.5%Mo	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb	Fe-17%Pt-20%Cr-3%Nb
保磁力 Hc/Oe	2.1	1.6	1.0	1.2	2.5	3.4	4.0
飽和磁束密度 B_S/kG	14.1	14.3	14.5	14.2	13.2	12.0	10.4

[0034]
[Table 3]
冷間加工＋1000 ℃, 5時間＋炉中冷却

	Fe-33%Pt	Fe-30%Pt	Fe-29%Pt-1%Nb	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb
保磁力 Hc/Oe	8.0	4.0	3.1	3.6	3.8
飽和磁束密度 B_S/kG	13.5	13.1	13.6	12.2	10.7

4, 5, 6 best

[0035]
[Table 4]
冷間加工＋1200℃, 1時間＋氷水中冷却＋600 ℃, 5時間＋大気中冷却

	Fe-33%Pt	Fe-29%Pt-1%Nb	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb	Fe-17%Pt-20%Cr-3%Nb
保磁力 Hc/Oe	8.2	5.0	6.1	4.5	7.7
飽和磁束密度 B_S/kG	14.1	13.9	12.2	11.0	10.3

[0036]

[Table 5]
精密鋳造材+1000℃, 5時間+大気中冷却+600℃, 10時間+大気中冷却

	Fe-33%Pt	Fe-29%Pt-1%Nb	Fe-28%Pt-7%Cr-1.5%Nb-0.5%Si	Fe-25%Pt-10%Cr-0.5%Nb	Fe-17%Pt-20%Cr-3%Nb
保磁力 Hc / Oe	9.2	4.2	5.5	5.7	8.6
飽和磁束密度 B_s / kG	13.1	13.3	12.0	11.4	10.2

[0037]
[Example] Hereafter, this invention is explained based on the example using the alloy in which each above-mentioned property is shown.
[Example 1] The binary system alloy which consists of Pt33%, the remainder Fe, and a small amount of impurity in a vacuum was dissolved with the RF fusion furnace, and the ingot with an outer-diameter [of 8mm] x die length of 60mm was obtained by metal mold casting. This was processed to 85% of reduction of area by swaging between the colds, and the round bar with an outer diameter of about 3mm was obtained. After starting die length of 30mm and heating at the temperature of 1000 degrees C in a vacuum from this for 5 hours, it cooled among atmospheric air. The value high forward [0.2VvsNHE(s) and forward] in the natural electrode potential of the anodic polarization property in 0.9% physiological saline to this alloy was acquired, and was a good value like 1.3VvsNHE(s) also in pitting potential. Moreover, it was 2.1Oe(s) and saturation magnetic flux density was 14.1kG(s), and although some soft magnetic characteristics were inferior in these as compared with corrosion-resistant stainless steel, corrosion resistance was very good [coercive force Hc]. In the die-length direction, the suction forces which have the same cross section and to which a maximum energy product acts between the Fe-Pt system magnet alloys of 15MGOe(s) were 460gf(s), when 810gf(s) were attained to and they were made to arrange in parallel in the diameter direction. The former is a usable suction force, when it uses for a small solenoid valve etc.
[0038] [Example 2] The alloy which consists of Pt29%, Nb1% and the remainder Fe, and a small amount of impurity in an atomic ratio was dissolved in the vacuum with the RF fusion furnace, and the ingot with an outer-diameter [of 8mm] x die length of 60mm was obtained by metal mold casting. From now on, the part with a die length of 2mm was started, and it cooled among the after [homogenization] furnace of 5 hours at the temperature of 1000 degrees C. After carrying out mirror plane polishing of the front face of this disc-like sample, when the suction force which acts between the Fe-Pt system magnet alloys which have the maximum energy product of 15MGOe was measured, 560gf (s) of practically sufficient reinforcement were obtained. Moreover, although Fe was eluted 5.0microg/cm2 when it was immersed for seven days into 0.9% physiological saline, where both are combined, the elution volume of Nb and Pt was a minute amount below limit of detection. The shape of a thin disk type has a dimension equivalent to electromagnetic components, such as a magnetic chuck, and is a usable suction force in passage, such as corrosion gas.
[0039] [Example 3] The alloy which consists of Pt28%, Cr7%, Nb1.5%, Si0.5% and the remainder Fe, and a small amount of impurity in a vacuum was dissolved with the RF fusion furnace, and the ingot with an outer-diameter [of 6mm] x die length of 80mm was obtained by metal mold casting. The ingot was processed 90% or more of working ratio with forging and roll rolling between the colds, it operated orthopedically to tabular [with a 0.7mm/ in thickness / x width of face of 8mm], and the part with a die length of 20mm was started after this. Homogenization heat treatment of this was carried out at the temperature of 1000 degrees C for 24 hours, and it cooled among after [5 hour heating] atmospheric air at the temperature of 600 degrees C in the vacuum further after supplying underwater. When the Fe-Pt system magnet alloy which polishes the front face of this sheet metal-like sample and has maximum energy product 15MGOe of the same area after smoothing was made to contact and it was immersed for

seven days into 0.9% physiological saline, 4.6microg/cm2 was eluted by Fe, 0.05microg/cm2 and Si were eluted by Cr 0.02microg/cm2, and Nb and Pt were below limit-of-detection values. This sheet metal is the example of the dimension which assumed embedding in the living body for the purpose, such as lips closing, and is orthopedically operated in a desired gestalt with a press etc. after this. The suction forces in the condition of having magnetized in the thickness direction and having made consistency having combining both were 430gf(s), and were practically effective values.

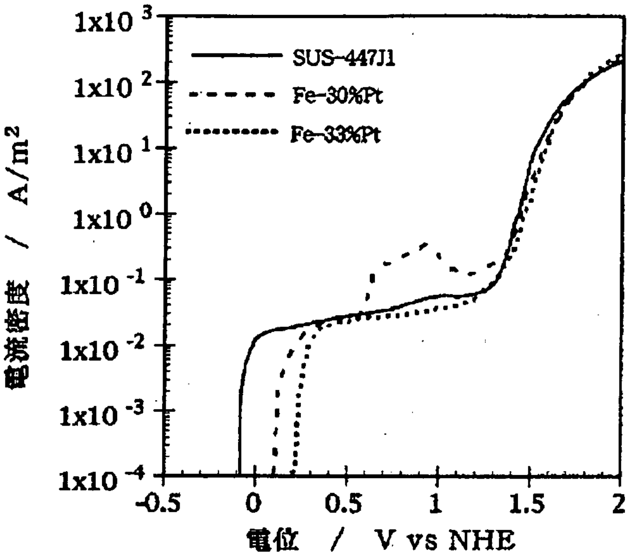
[0040] [Example 4] The alloy which consists of Pt17%, Cr20%, Nb3% and the remainder Fe, and a small amount of impurity was cast in the gestalt of the inner cap of orthoprosthesis, and it cooled among after [heating between five] atmospheric air at the temperature of 1000 degrees C in the vacuum by the precision casting which combined a RF fusion furnace and Ar gas pressure Hasama casting in the vacuum ambient atmosphere. When immersed for seven days into the outer cap which consists of a Fe-Pt system magnet alloy which has the maximum energy product of 15MGOe(s) produced by the same casting approach, and combination and 0.9% physiological saline, Fe was eluted 0.03microg/cm2 and was [3.9microg/cm2 and Cr of Nb and Pt] below limit of detection. This is a small elution volume below the value usually observed in the dentistry field. Moreover, the suction force which acts among both who adjusted the contact surface was 610gf, and was practically sufficient suction force.

[0041]

[Effect of the Invention] We are anxious about the elution of nickel considered that each of York by the magnetic stainless steel used conventionally, keepers, implant, etc. has many Fe(s) of a configuration element, and elution volumes of Cr, and it produces allergy to the body especially. The alloy in connection with this invention uses as a principal component Pt which has very high safety to living body toxicity, and Fe element, and an accessory constituent is excellent in corrosion resistance, and consists of elements effective in improvement in soft magnetic characteristics. Therefore, especially when it excels in the biocompatibility which can be used for insurance within a living body front face or the oral cavity according to such effectiveness, and a corrosion resistance high soft magnetism alloy is obtained, it combines with a commercial magnetic attachment and it considers [not to mention] as combination structure with a Fe-Pt system magnet, the outstanding effectiveness is demonstrated and the positive activity of a magnet in the living body is enabled. the application, for example, an electromagnetic component, in which the general properties of an ingredient of having soft magnetic characteristics, such as the magnetic-shielding effectiveness and the magnetic-induction effectiveness, were otherwise harnessed, and electromagnetism -- since it is suitable for the keeper of a device, medicine and health tools, and orthoprosthesis, and the functional components for pads in the living body, it is a industrial very useful soft magnetism alloy.

[Translation done.]

Drawing selection Representative drawing



[Translation done.]